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DRAFT TRANSLATION

DETECTION OF THE INNER RADIATION BELT AT 320 KM ALTITUDE IN THE REGION OF THE SOUTH ATLANTIC MAGNETIC ANOMALY

(Obnaruzheniye bnutrennego radiatsionnogo poyasa na vysote 320 km v rayone yuzhno-atlantichesoy magnitnoy anomalii)

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The presence of magnetic anomalies at the surface of the Earth may substantially influence the disposition of radiation belts [1]. There is in the southern part of the Atlantic Ocean a region with abnormally small value of magnetic field intensity It may be as low as 0.25 oersted at certain areas of the Brazilian coastline. Thus, one may expect that the boundary of the inner radiation belt over the South Atlantic is situated at substantially lower altitudes.than in other regions [2]. An increased radiation intensity was registered by the radiometric devices installed aboard the second Soviet spaceship-satellite during its flight above the regions of the South Atlantic magnetic anomaly. A gas-discharge counter STS-5, and a scintillation counter (FEU-16 with a sodium iodide crystal with a cylindric shape, 14 mm high and 30 mm in diameter) were located inside the spaceship-satellite. The scintillation counter registered particles with a 25 keV threshold, and the aggregate energy liberation in the NaJ(Tl) by the FEU's anode current. From the counters the information entered every three minutes into a 24-hour capacity memory device. The processing of the obtained data allowed to establish that the spacecraft crossed areas with an increased radiation intensity in a series of regions of the terrestrial globe through which it moved.

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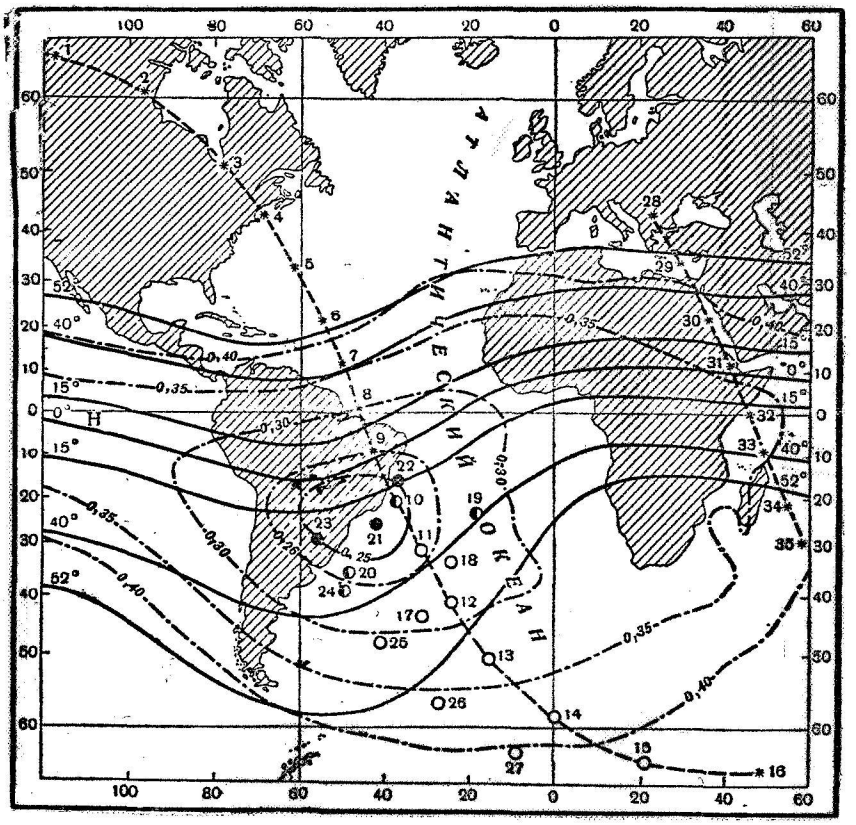

Fig. 1

The area of increased radiation intensity as recorded by the gas-discharge counter STS-5. Circles mark the points where the counting rate exceeded 3.6 pulse/cm^2 - sec. The black dots denote areas where the counting rate of the gas-discharge counter exceeded that of the scintillation counter by over 15 per cent; the unshaded circles denote the excess less than 5 per cent, and the half-shaded circles indicate the areas where the corresponding increase was between 5 and 15 per cent. Isoclines are represented by continuous lines, sections of the spaceship trajectory are indicated by broken lines and the dash-and-dot lines show the lines of equal intensity of the magnetic field B (the values of B are given in gausses).

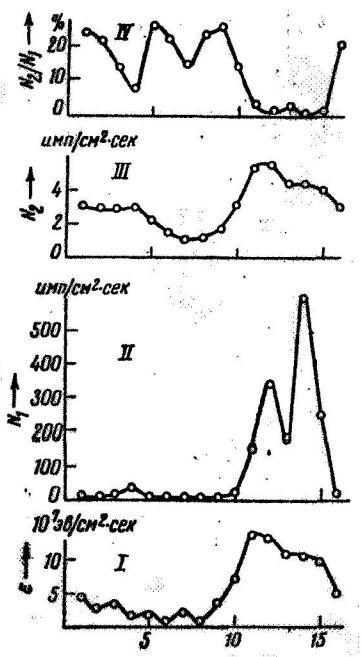

Fig. 2. Data obtained with the gas-discharge and the scintillation counters for a section of the trajectory of the spacecraft over the South Atlantic.

I.- Energy liberation in the crystal of the scintillation counter
II.- Counting rate of the scintillation counter
III.- Counting rate of the gas-discharge counter STS - 5
IV.- Ratio between the two counting rates.

The number of points indicated on Fig. 1 are marked off on the abscissa axis.

It has been pointed out in reference [3] that all these areas are linked with the Earth's outer radiation belt. The region of the negative magnetic anomaly at the Brazilian coast constituted the only exception. Because of its geographic position at small geomagnetic latitudes, this region could not be related to the outer radiation belt. Besides, it differs from the other regions by a comparatively high counting rate of tye gas-discharge counter, which attests about the presence in the radiation of a notable number of penetrating charged particles.

The points where the gas-discharge counter's counting rate exceeded 3.6 pulse/ cm^2 -sec. are indicated by circles on the map in Figure 1. (The convesrion of the counter's reading to 1 cm was effected in the assumption of registered radiation's isotropism). It resulted, that all such points were concentrated in the southern part of the Atlantic Ocean, and that the counting rate of the gas-discharge counter did not exceed 3.6 pulse/cm^2 -sec at any other spot of the terrestrial globe. Isoclines for a series of angles of inclination, and several lines of equal intensity of the Earth magnetic field B, are also plotted on the same map.

The comparison of all counters' indications in the South Atlantic with those of other regions of the globe may be made with the help of the graph on Figure 2, and of Table 1.

A unique point numbering was used in Fig. 1, Fig. 2, and Table 1, where measurements of the counting rate and of energy liberation in the NaJ(Tl) crystal were made. The points where the counting rate of the counter STS-5 was lower that 3.6 p lse/cm^2-sec are indicated by starlets in Figure 1 (only a limited part of these points is brought forth in this paper).

Points numbers 10 and 22 constitute an exception: The gas-discharge counter's counting rate there, though somewhat lower than 3.6 pulse/cm sec, still considerably exceeded the counting rate characteristic of the given magnetic latitude φ (determined according to magnetic inclination angle δ with the aid of the relation $2\,\mathrm{tg}\,\varphi = \mathrm{tg}\,\delta$).

Points with numbers 1 through 16 belong to the same convolution trajectory of the spaceship-satellite, and that is why Fig. 2 represents the sequential variation of counter readings when shifting from polar regions of the northern hemisphere through the equator and the Brazilian anomaly into the polar region of the southern hemisphere.

It may be seen from the data presented, that the readings of all data sensors beyond the limits of the anomalous region increase 3 to 4 times at passing from the equator (points numbers 6 through 8, and 18 through 21) to pplar latitudes (points 1 through 4 and also 16), which is naturally explained by latitude effect of cosmic rays. At the same time the gas-discharge counter's counting rate constitutes constitutes 15-25 percent of the scintillation counter's rate (with the exception of points 3 and 4, in which the effect of the outer radiation is being felt [3]).

Observed is in the anomalous region, beginning at 7° Southern magnetic latitude such a rise of counter readings that it can only be explained by the manifestation of the Earth's inner radiation belt. In the region of low magnetic latitudes ($< 20^\circ$) the counting rates of the gas-discharge and scintillation counters also increase in a similar degree, so that the relation of these rates is little different from 20 percent. This leads to the conclusion that the counting rate

TABLE 1

READINGS OF THE GAS DISCHARGE AND SCINTILLATION COUNTERS AT POINTS INDICATED ON THE MAO, FIG. 1

Number of the point	Magnetic latitude	Scintill counter: energy liberation in NaJ(Tl) 10^7 eV/cm²·sec	Scintill counter: count. rate N_1 pulse/cm²·sec	Counting rate of STS-5 N_2 p/cm²·μ	N_2/N_1 Count
Portion of the trajectory crossing the anomalous reg.					
1	74,5°	4,4	13	3,26	25
2	78°	3,0	13	2,86	22
3	70,5°	3,5	20	2,90	14,5
4	69°	2,1	38	3,00	7,9
5	49,5°	2,0	8,5	2,30	27
6	35,5°	1,0	6,5	1,50	23
7	24,5°	2,2	6,5	1,00	15,5
8	11°	0,8	5,0	1,20	24
9	1,5°	3,6	6,5	1,72	26,5
10	−11,5°	7,4	21,7	3,16	14,5
11	−21°	14,0	154	5,40	3,5
12	−29°	13,3	344	5,50	1,6
13	−37,5°	10,7	178	4,45	2,5
14	−45,5°	10,7	608	4,30	0,7
15	−51°	10,1	248	4,10	1,6
16	−54°	4,8	15	3,30	22
Anomalous region					
17	−27,5°	13,5	227	8,25	3,6
18	−24,5°	14,0	155	5,60	3,6

Number of the point	Magnetic latitude	Scintill counter: energy liber. in NaJ(Tl) 10^7 eV/cm²·sec	Scintill counter: count N_1 pulse/cm²·sec	STS-5 count N_2, pulse/cm²·sec
Anomalous region				
19	−22°	8,2	27	3,06	14,7
20	−18°	9,0	62	5,60	8,0
21	−14,5°	8,7	35	9,90	28
22	−7,5°	5,2	13,5	3,14	23
23	−12,5°	3,7	20	3,80	19
24	−20°	4,4	52	3,89	7,3
25	−28,5°	3,0	107	3,68	3,4
26	−35,5°	8,6	120	4,35	3,6
27	−44,5°	11,8	317	4,58	1,5
Portion of the trajectory not intersecting the anomalous reg.					
28	40°	2,0	8,5	1,80	21
29	31°	1,0	5,0	1,30	26
30	16°	2,2	6,5	1,00	15,5
31	0°	1,3	5	0,80	16
32	−11,5°	0,9	5	1,00	20
33	−23°	0,9	5	1,10	22
34	−35°	1,3	6,5	1,20	18,5
35	−43°	2,0	8,5	1,40	16,5

increase in the anomalous region within the indicated latitudes is basically determined by protons. With the increase of the magnetic latitude the counting rate of the scintillation counter N_1 sharply increases, while that of the gas-discharge counter falls as an average, so that the relation N_2 / N_1 decreases to 1.6 percent (point 12). This implies that in the sector of the anomalous region, situated to the south of the 20th degree of magnetic latitude, X-ray (roentgen) brehmstrahlung from electrons of the inner radiation belt is clearly revealed, while the intensity of the proton component drops. At points to the south of 40° soutern magnetic latitude (points 14, 15, 27) the STS-5 counter's counting rate may be entirely ascribed to the

combined action of the primary cosmic and the X-ray brehmstrahlungs, if we assume that the effectiveness of the gas-discharge counter STS-5 to X-ray quanta constitutes 0.5 percent or more. Accounting for the geographic situation, this circumstance permits us to relate the indicated points to the outer radiation belt.

The conclusions which may drawn on the basis of the above-described facts and thoughts, amount to the following :

1.- The increased radiation intensity detected by us during the flights of the second Soviet spaceship-satellite at 320 km altitude over the region of the Brazilian magnetic anomaly is dependent upon the inner radiation belt of the Earth. To the north of the geomagnetic equator the inner belt is not evident at such altitudes, inasmuch as the magnetic field intensity, and consequently that of the points' specular reflection, are disposed higher than in the anomalous region.

2.- The proton component of the inner radiation belt predominates at low geomagnetic latitudes of the anomalous region. As the latitude increases, the intensity of X-ray radiation, appearing at electron deceleration in the spaceship's casing, increases also. At the same time the intensity of the proton component decreases.

3.- The outer radiation belt appears at magnetic latitudes above 40°.

4.- There exists a transition region between the outer and the inner radiation belts, in which the brehmstrahlung intensity is respectively 2 and 4 times lower than in the maxima of intensity of the inner and outer radiation belts at the given altitude.

5.- The gap between the inner and the outer radiation belts, so clearly revealed in the northern hemisphere during the flights of the third Soviet spaceship-satellite [4], is practically absent in the region of the Brazilian anomaly. This experimental fact, together with the data on the magnitude of the gap in the northern hemisphere and

near the equator [6], may throw light on the origin of the Earth's outer radiation belt.

**** E N D ****

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